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USING MOLECULAR TEMPLATING TO BUILD NANOMETER-SCALE SQUIDS

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We have successfully shown that nanometer scale superconducting quantum interference detectors (SQUIDS) can be constructed using a suspended molecular template technique along with a method of electron beam deposition (EBD) of carbon using a scanning electron microscope (SEM). A rectangular chip, which had a top layer of silicon nitride and a 100 nm trench running down its center, was etched in hydrofluoric acid to ensure the middle layer of silicon oxide was underetched away from the bottom of the trench. Solutions both of regular and fluorinated single-walled carbon nanotubes were deposited on the surface of the chip, and nanotubes were found to exhibit bridge-like behavior by crossing the trench in an irregular and often random pattern. Ambient or local carbon from the imperfect vacuum chamber of the SEM was then used to grow triangular loops on these carbon nanotube bridges by using the EBD technique. If necessary, reactive ion etching was used to decrease the widths of the carbon structures themselves. A thin film of Molybdenum-Germanium (MoGe) superconducting alloy was then sputtered onto the entire surface of the silicon chip. Photolithography was used to create an electrode pattern from the film of MoGe on the surface of the chip. Gold wires were then ready to be attached to the electrodes so that current and voltage across the electrodes could be measured within a liquid helium environment. This particular SQUID geometry created allows for the quantized magnetic flux through the enclosed loop area to be accurately measured, as well as allowing the opportunity to study the magnetoresistance properties.